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Designation: Device with a fluidised bed chamber capable of connection to a pressure or suction source for hot gas

Applicants: CIBA-GEIGY AG, Basel (Switzerland)

Representatives: Berg, W.J., Dipl.-Chem. Dr. rer. nat.; Stapf, O.F., Dipl.-Ing.,  
Patent Attorneys, 8000 Munich

Inventor: Kaspar, Jan, Dipl.-Ing., Muttenez; Voegtlin, Reinhard, Duggingen  
(Switzerland)

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Printed documents to be taken into consideration in the assessment of patentability:

DT-PS	9 36 386
DT-PS	9 74 769
DT-OS	16 67 058
DT-OS	18 13 286
DT-OS	19 06 895
DT-GM	18 30 427
US	35 08 341

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GERMANY

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12 July 1973

Device with a fluidised bed chamber capable of connection to a pressure or suction source for hot gas.

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With previously-known fluidised bed chambers, the hot intake air is conducted through a chamber floor designed in the form of a screen or sieve. This has the disadvantage that the hot intake air by and by heats the sieve floor to its own temperature. It is known, however, that because of the constant circulatory movements a substantially lower temperature pertains in the fluidised bed than that of the intake air, with the result that the effort must be made to select the latter to be sufficiently high for the optimum maximum temperature which is just still permissible to pertain in the cooler fluidised bed. If the sieve floor now assumes the temperature of the intake air, it is substantially hotter in comparison with the fluidised bed, and the risk arises that the material located in the fluidised bed, which is often heat-sensitive, may be damaged when in contact with the sieve floor, or adhere to it, which leads relatively rapidly to the clogging of the sieve floor and therefore to operational faults or interruptions. In order to avoid this, the intake air temperature is only selected to be high enough for the floor not to be heated above the temperature range which is critical for the material in the fluidised bed. As a result of this, substantial losses in performance output must be taken into account, since the temperature in the fluidised bed therefore cannot have the optimum value.

A further disadvantage of sieve floors lies in the fact that for technical operational reasons they cannot have the most favourable flow resistance values. It is known that the operational conditions in the fluidised bed are optimum when the flow resistance of the sieve floor is at least equal to that of the fluidised bed. In practice, the flow resistance of the fluidised bed, expressed by the pressure drop from the lower to the upper edge of the bed, is between 5 and 20 mbar. A relatively high pressure drop such as this can only be produced with a relatively fine mesh sieve floor. This incurs technical operational problems, however; for example, such sieve floors are not very mechanically strong, easily become clogged, and are very troublesome to clean. In practice, therefore, narrow-mesh sieve floors are dispensed with, which in turn means doing without optimum flow resistance, and wide-mesh sieve floors are used which are not mechanically so problematic, and less than optimum operational conditions in the fluidised bed have to be taken into account.

The problem of the invention is the avoidance of the deficiencies and disadvantages described heretofore. The invention relates to a device with a fluidised bed chamber capable of being connected to a pressure or suction source for hot gas, and for hot air in particular, and is characterised in that the inflow apertures for the hot gas into the fluidised bed are arranged at a distance above the chamber floor, and are directed onto this in terms of their flow direction, and that all those parts of the hot gas inflow ducts which are in heat-transfer contact with the interior of the chamber are thermally insulated.

The invention avoids the problem of the hot air heating the chamber floor or the chamber walls and thereby overheating the material in the fluidised bed when it comes in contact with the floor or wall. Since all the ducts conducting hot air which open into the chamber are thermally insulated at least inside the chamber, the fluidised bed material which comes in contact with these ducts cannot be damaged either. Accordingly, the intake air can be brought to the optimum high temperature for the particular operating conditions without any risk, and a substantial increase in performance is therefore achieved in comparison with the known devices.

In addition to this, the inflow ducts into the chamber can be very simply designed in such a way that they have the flow resistance required in each case, and thereby an improvement in performance is also achieved in comparison with the known devices.

The invention is explained in greater detail hereinafter on the basis of the embodiments shown in the drawings. These show:

Fig. 1            A first embodiment in a vertical section,

Fig. 2            The detail designated by II from Fig. 1, in an enlarged representation,

Fig. 3            A section along the line III-III in Fig. 1,

Figs. 4 and 5    Each a detail variant on Fig. 2,

Fig. 6            A section along the line VI-VI of Fig. 2,

and

Fig. 7            A further embodiment in a considerably simplified vertical sectional representation.

In Fig. 1, 1 designates an upright fluidised bed chamber, which comprises a bottom, narrower section, and an upper, broader cylindrical section, as well as a conical section located between them. An outlet air duct 2 opens into the upper chamber section with a suction fan 3. A dust filter 4 is provided in the upper chamber section to screen out dust which eddies upwards. Instead of the dust filter 4, it would also be possible to make use of a cyclone for dust separation. The dust which is screened out may then, if appropriate, be conducted back into the fluidised bed.

The inflow pipe of an infeed device 5 for the material to be treated in the chamber in the fluidised bed opens into the middle chamber section. In this situation, fluid can be sprayed into the fluidised bed by means of a nozzle 6. The nozzle is capable of being pivoted by means of a bar arrangement 7 and a drive motor, not shown, in such a way that it can encompass the entire surface of the fluidised bed.

An extraction pipe 8 for the finished material treated in the fluidised bed opens into the lower chamber section. The pipe 8 can be opened and closed by means of a flap 10, pivoted by a motor 9.

The floor II of the fluidised bed chamber 1 is designed with a double wall. Pipe sockets 12 are inserted into it, distributed over the entire cross-section surface, which establish a connection with the interior of the chamber and an air distribution shaft 13 located beneath the chamber floor. Said shaft is connected to the atmosphere via an intake air duct 14. Arranged in the intake air duct 14 are a throttle flap 15 and a heat register 16, by means of which the quantity and temperature of the intake air can be regulated. Instead of the suction fan 3 in the outlet air duct 2, it would also be possible to arrange a fan in the intake air duct.

The design of the chamber floor 11 and the pipe socket 12 is shown in a larger scale in Fig. 2. The floor 11 is formed in this case by an upper plate 17 and a lower plate 18, whereby on the inner side of the latter an asbestos layer 19 is secured. The two plates 17 and 18 are connected to one another by a spacer pipe 20.

In this situation, the space located between them is sealed gas-tight against the outside. The entire floor 11 rests on a base 21 which projects from the wall of the shaft 13, and is bolted to the securing lobes 22 which project from the wall of the lower chamber section. The bolts 23 are in each case guided through sleeves 24 which are welded to the two plates such as to form a tight seal.

The pipe sockets 12 each consist of a longer and a shorter double-walled pipe element 25 and 26 respectively, which are welded together at an acute angle. In this situation, the outer pipe and the inner pipe are in each case connected only at both ends of the pipe socket, so that the minimum possible heat bridges pertain between the two pipes, and the outer wall of the pipe sockets 12 is thermally insulated against the inner wall. The longer pipe element 25 of each pipe socket 12, in a similar manner to the bolts 23, is guided in a sleeve 2 through the double-walled floor 12 as far as a stop 27, and is tightened with a ring nut 29. The apertures 30 of the shorter pipe elements 26, which form the inlet apertures into the chamber for the intake air, are located in this situation at a distance above the chamber floor, and point towards it. The outlet direction of the air flow from the pipe element 26 is for preference inclined at an angle  $\beta$  of about  $20^\circ - 30^\circ$  to the floor, but may be at a sharper or flatter angle.

Fig. 3 shows a possible arrangement of the pipe socket above the entire chamber floor. The arrows 31 indicate the horizontal component of the direction of flow in each case. As can be seen, all the arrows 31 have the same direction of rotation in respect of the axis 32 of the chamber. By rotating the pipe socket 12 in the floor 11, the direction of the flow can be changed at will.

The device described functions as follows: The fan 3 sucks atmospheric air through the duct 14. In the duct the air is heated to the desired temperature, and passes via the air distribution shaft 13 and the pipe socket 12 into the fluidised bed chamber 1, where it causes the material to be treated to eddy and creates a fluidised bed. From the fluidised bed the air then passes through the filter 4 and the outlet air duct 2 back into the atmosphere.

Due to the fact that all the parts of the inflow ducts for the hot air intake, which come in heat-transfer contact with the interior parts of the chamber, i.e. the floor 11 and the pipe socket 12, are thermally insulated, the eddying material in the chamber does not come in contact with excessively hot floor parts or pipe sockets, and is therefore not damaged. The eddying material is only heated up by the hot air, not by floor or wall contact. The upper plate 17 of the floor, i.e. on the chamber interior side, and the outer pipes of the pipe sockets 12, are not impinged upon by the hot intake air, and as a consequence are not heated to its temperature. Rather, these parts are constantly being cooled by the ongoing contact with the eddying material, since the heat transfer coefficient between the fluidised bed and the metal parts is relatively high. Since this allows the risk of damage to the material due to overheating by contact with the floor to be excluded, the temperature of the intake air can be adjusted to the optimum value in each case.

It is of course not absolutely necessary for the floor and air inlets to be designed as double-walled for the purpose of thermal insulation. Instead, a suitable insulating material could also be used. However, the double-wall design has proved its worth in practice for technical design reasons. In addition, stainless steel can be used for this, which incurs no maintenance problems and is of advantage in practical use.

With many fluidised bed granulation processes, it is usual for fine portions of the granulate incurred, which are below a certain grain size, to be returned to the fluidised bed. In Fig. 1, 33 designates a piping system, which is secured to the chamber floor 11, and serves to reintroduce this fine-grain material into the fluidised bed chamber. This pipe system consists, according to Fig. 6, of angle profile elements 34, welded to the upper plate 17 of the floor, which branch in fork fashion as indicated by the dotted line in Fig. 3.



These profile elements 34 accordingly form pipes, triangular in cross-section, with the floor, and are connected to an infeed duct for the powder material which is to be introduced. As can be further seen from Fig. 6, the profile elements 34 feature a row of apertures 37 on both sides, through which the powder material is sucked due to the underpressure which prevails in the fluidised bed chamber. In this way this fine portion can be reintroduced at the optimum position, i.e. in the immediate vicinity of the floor, which is not possible with conventional granulate chambers with sieve floors, since the pipes would in that case cover a part of the sieve floor.

Instead of the pipe sockets 12 of Figs. 1 and 2, it is also possible to use those such as are shown in Fig. 4. The pipe sockets shown in Fig. 4 consist of a straight double-walled pipe 38 and a double-walled screen 39. The screen 39 deflects the air jet emerging from the pipe in the direction of the floor, and prevents the eddying material from falling into the pipe when the fan is switched off. Instead of the double-walled design, it would of course also be possible in this case to use a suitable insulating material.

Instead of the pipe sockets of Figs. 1, 2, and 4, elements with nozzle-like slots can also be used.

Such an element is shown in Fig. 5, for example, and consists of a shaft-like lower part 40 and an upper part 41 of the same shape, whereby the air outlet aperture is formed by a relatively wide slot 42.

Fig. 7 shows that the air intakes do not always open through the chamber floor, but can also pass through the chamber walls into the fluidised bed chamber. For this purpose the lower chamber section is encompassed by an annular channel 51, which forms an air distributor and is in connection with the intake air duct 52. In the area of the annular channel 51, the chamber wall 53 is thermally insulated, in this case designed as a double wall. Intakes 54 with the apertures facing downwards are located in the chamber wall 53, and establish the connection between the interior of the chamber and the annular channel 51. In this case too, the number and special shape of the air inlets can be adapted to the individual circumstances. Instead of the pipe sockets 54, it would also be possible for slot nozzles to be used, running in ring fashion around the entire circumference of the chamber.

It is also possible to do away with insulation on the chamber floor or the chamber wall, if the hot air is kept away from these parts. For example, it would be possible for this to be achieved if the pipe sockets or other air intakes are connected in each case by separate ducts to an air distributor or a manifold line, spatially separated from the fluidised bed chamber.

Another problem with such fluidised bed chambers is resolved with the device according to the invention with thermally-insulating inflow ducts, and leaving out a sieve floor. The inflow ducts in the area of the chamber floor or its walls, in other words the pipe sockets or other air intakes, can be very simply designed in such a way that their flow resistance best accords with the individual circumstances in each case (in practice, 5-20 mbar pressure differential). This allows for a substantially better performance output to be achieved than with conventional sieve floor chambers.

Thanks to the unrestricted adaptation possibility of the flow resistance of the air inlets, and the unrestricted adaptation possibility of the air intake temperature to its optimum value, it is possible, with a device according to the invention to achieve improvements in output performance of 80 % and more in comparison with known devices of this nature. The device further has the advantage that it is very easy to clean (no mechanically sensitive sieve) and therefore does not require any major maintenance.

The fluidised bed is more regular than usual, and the grain distribution is more homogenous throughout the entire bed than with the previously known devices. By means of a suitable arrangement of the air intakes, such as in Fig. 3, it is possible to achieve a situation in which there is no material deposited on the floor at all, but rather that the floor is constantly swept clear by the eddy flow in the fluidised bed.

1. Device with a fluidised bed chamber capable of connection to a pressure or suction source for hot gas, and for hot air in particular, characterised in that the inflow apertures for the hot gas into the fluidised bed chamber are arranged at a distance above the chamber floor, and, with regard to their direction of flow, are directed towards the floor, and that all those parts of the inflow ducts of the hot gas which are in heat transfer contact with the interior of the chamber are thermally insulated.
2. Device according to Claim 1, characterised in that the flow directions of the inflow apertures form acute angles ( $\alpha$ ) with the directions pointing from the inflow apertures to the centre of the fluidised bed chamber.
3. Device according to Claim 2, characterised in that these angles ( $\alpha$ ) and/or the inclination angle ( $\beta$ ) of the directions of flow of the inflow apertures are adjustable in relation to the chamber floor.
4. Device according to Claims 2 or 3, characterised in that the tangential components of the flow directions of essentially all the inflow apertures have the same direction of rotation.
5. Device according to Claim 1, characterised in that the inflow ducts are formed in the area of the chamber floor by pipe sockets, with a deflection element arranged on their outlet side.
6. Device according to Claim 5, characterised in that the deflection elements are designed to be hood-shaped.
7. Device according to Claim 5, characterised in that the deflection elements are formed in each case by an angled pipe element.
8. Device according to Claim 1, characterised in that the inflow apertures are designed in the form of a slot nozzle.
9. Device according to Claim 1, in which the hot gas is conducted to the chamber floor in a manifold line, characterised in that the floor is designed as double-walled and/or consists of an insulating material.
10. Device according to Claim 1 or 9, characterised in that the hot gas is conducted to the chamber floor in a manifold line, and that the wall is double-walled at least in the area of this manifold line and/or consists of an insulating material.

11. Device according to Claim 1, characterised in that the thermally-insulating parts of the inflow ducts are designed to be double-walled.
12. Device according to one of Claims 1 to 11, characterised in that the flow resistance occurring at the inflow ducts in the area of the chamber floor and/or the chamber wall amounted to some 5-20 mbar, and for preference some 7-15 mbar.
13. Device according to one of Claims 1 to 12, characterised in that introduction means are arranged on the chamber floor for the introduction of powder material into the fluidised bed chamber.
14. Device according to Claim 13, characterised in that the introduction means are formed by pipes connected to a feed line, which are for preference flat on their underside and feature lateral apertures.
15. Device according to Claim 14, characterised in that the pipes are triangular in cross-section.
16. Device according to Claims 2, 4, 7, and 11.
17. Device according to Claims 9 and 16.

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FIG. 2 2335514

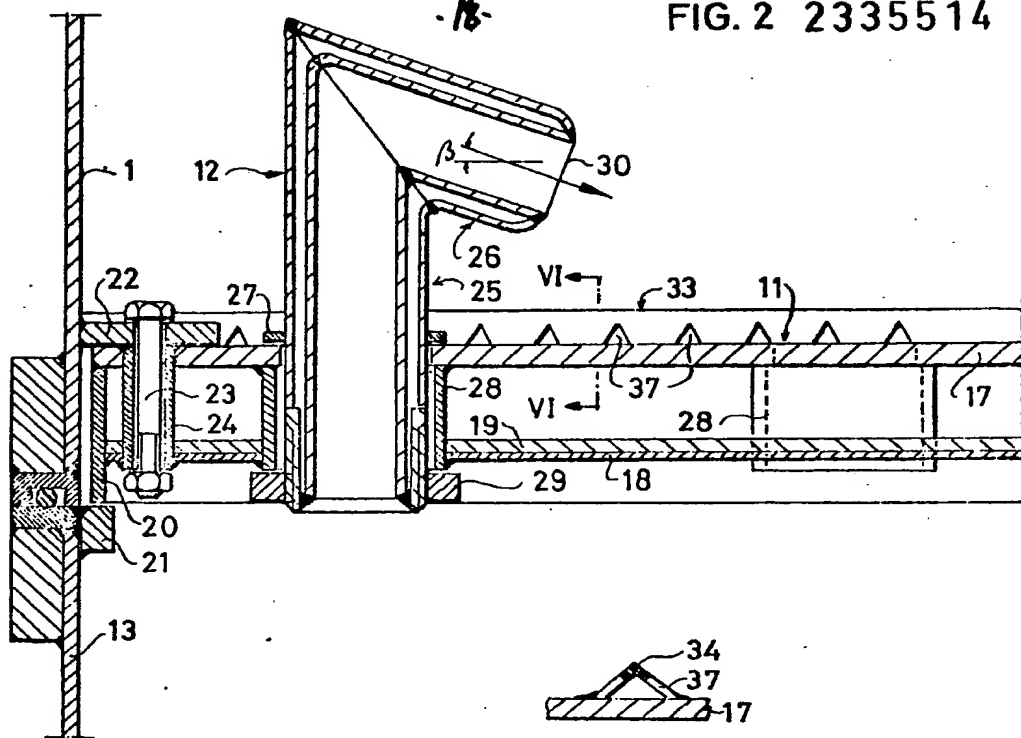


FIG. 6

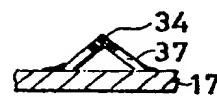


FIG. 4

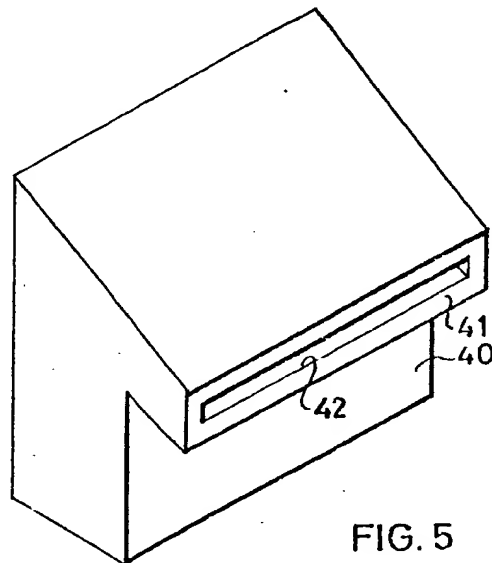
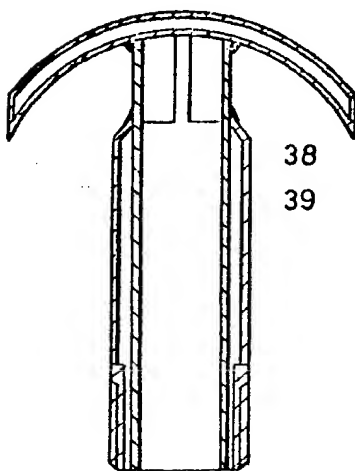


FIG. 5